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ABSTRACT

This paper assesses the utility of Piagetian theory for educational practice. Educational practice cannot be formally deduced from psychological theory, but may be theory-compatible if the theory does not specifically forbid the practice. Piaget's genetic epistemology has provided a theoretical justification for longstanding educational innovations. Practitioners may not realize, however, that even educational recommendations from operant theory are compatible with Piagetian theory. There are no clear-cut implications in Piagetian theory for sequencing curricula or for determining curriculum content. To make the Piagetian tasks part of the curriculum is as misguided as teaching IQ items to develop intelligence. Piagetian psychology has been richest in its generation of instructional procedures. All of the procedures can be shown sufficient within the limits cited for cognitive growth while none seem necessary for it. Many of these training strategies are applicable to all concepts, have face validity as classroom techniques and in many instances would seem to be a teacher's first choice for providing conceptual clarification. The chief legacy of Piagetian theory for instruction will continue to be the development and evaluation of specific training techniques for various school concepts. Perhaps the only certain educational recommendation from a theory such as Piaget's is that schools should simulate "natural" human development. (Author/RH)

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THE FUTURE OF PIAGET'S THEORY IN EDUCATION[1]

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There is no reason to think that the future of Piaget's theoretical influence in Education will follow a course different from the influence of other psychological theories upon Education. To paraphrase Guthrie's law--the best predictor of a theory's influence in a situation may be the record of the influence of other theories in the same situation. Thus we often see in the course of a theory's influence in Education an initial phase of intense acclaim and uncritical acceptance followed by a period of simplistic interpretation and application; or if you will, a period of accommodation without assimilation as in the cases where the Piagetian tasks become the curricular content, and assimilation without accommodation as in the cases of Piagetian IQ tests, instructional technology, counseling and therapy techniques. It is also to be expected that these developments will be followed by a period of sharply limited influence in which the Piagetian constructs will be reincarnated in a succeeding theory, much as the educational impact of the Herbartian doctrine of apperception reappeared in Ausbubel's advanced organizer notions or as the phonataby reading instruction innovation reappeared virtually intact 100 years later as ita, the initial teaching alphabet. Thus the Piagetian constructs will no doubt reappear in still another set of neologisms by which educators will rationalize and defend those educational practices and innovations which place a high instructional premium upon self-initiated and regulated "discovery" activity in situations that demand social cooperation, and which place an even higher curricular premium upon thinking and knowledge than on learning information and skills. In this respect Piaget's psychology has supplanted Dewey's psychology as open education supplanted progressive education (Silberman, 1970).

The validity of an educational practice is not guaranteed by its plausibility within nor its conformity to psychological theory even when the builders of the theory have created the educational technique. No better example of this fact exists than B. F. Skinner's programmed instruction innovation which, while a proven effective teaching technique, often as effective as a classroom teacher, appears surprisingly not to lose that effectiveness when various theoretical requirements Skinner placed upon it are violated. Even though the theory which gave birth to programmed instruction insists upon a linear shaping sequence of items to which overt responses are made and immediately reinforced, programs which scramble frames randomly, delay or omit reinforcement, and require only covert responding are as effective as their

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theoretically sanctioned counterparts. Indeed very often the practice far outstrips an academic discipline's facility of explanation for it, as in the case of folk medical practices whose efficacy remain unexplained. Long before Euclid, for example, organized geometry as a coherent discipline, Greek surveyors had successfully employed the Pythagorean and other theorems in their trade. It is clear that while the educational recommendations of Montessori are compatible with Piaget's theory they were developed independently of it and are true or false quite apart from the truth or falsity of Piaget's theory.

The nature of the educational implications of any theory is quite complex. At the highest criterion level, theoretical implications are those that can be deduced formally from the theory which means that their failure as educational practices would invalidate the theory. Few psychological theories are stated with the precision needed to construct formal deductions in any case, and perhaps for this reason there are no statements of legitimate educational recommendations derivable from Piaget's theory which would invalidate that theory if they were proved false by empirical failure. In fact, true educational practices may be deduced correctly from both true and false theories, which is another way of saying that the truth of an educational practice is not guaranteed by its place in a theory but by the careful and independent direct assessment of its effectiveness. As the correctness of theories is always in doubt, the business of science proceeds by the scientist's ability to think clearly, i.e., formulate truthful deductions, and to establish the truth or falsity of practices and other facts.

Since it does not seem possible to ground the statements of educational implications in formal deductive links to theory, a lower level criterion for an implication might be that it at least be compatible with the theory in the sense that it not be specifically proscribed by it.

While the criterion of compatibility with the theory is less stringent than deduction from the theory and while it consists of proscriptions rather than prescriptions for educational practice, theory still provides its traditional role as a heuristic for the generation of educational innovation and for prediction of likely educational outcomes.

Let us consider then what legitimate educational practices, if any, Piagetian psychology would or could proscribe. It is clear that Piaget's account of intellectual development still progresses and Piaget, now in his eighties, has modestly claimed that he has

> ...laid bare a more or less evident general skeleton which remains full of gaps so that when these gaps will be filled, the articulations will have to be differentiated, but the general lines of the system will not be changed (Sinclair-deZwart, 1977, p. 1).

That the theory would be open ended and tentative and subjected to major revisions by Piaget is in part a validation of it as a developmental theory which is developing. Certainly modifications in the theory are required by the research findings of hundreds of researchers which demonstrate the surprising competence of the younger child and unevenness in adult thought. These findings have blunted the distinctions between the classic stages and softened the claims of the differences between children, adolescents and adults. Moreover, the logical-structural account of the stages will need to give way to more powerful explanatory models (Murray, in press).

Still the general lines of the system remain and to understand the implications of Piaget's theory of intellectual development for educational practice one must first understand that the theory is not a psychological or educational theory. It is not concerned primarily with the explanation and prediction of psychological or educational phenomena, although it may illuminate these phenomena. The theory has its origins in certain classic epistemological questions which it proposes to resolve through a treatment of how these philosophical concepts, dilemmas, paradoxes have evolved and developed in the thought of an abstract epistemic being who is free of culture, SES status, sex and any other mark of individuality.

Schooling is largely, and perhaps to some extent mistakenly, concerned with the acquisition of information (which is the country's population, capital?) and skills (3Rs), while Piaget's theory is concerned with the development of knowledge and thinking, i.e., things we know are true because they must be true, they have to be true, because they are consistent, have coherence and can be deduced from other things. The relationship between information and knowledge, content and structure, is subtle and profound. Whatever implications there are from genetic epistemology for education, they are restricted to the knowledge of things that are necessarily true, that are always true, that have to be true, and the process by which such knowledge develops. The relation and dependence of this knowledge upon information and fact, arbitrary as it might be, is a major research and theoretical problem of the decade for the behaviorial sciences and education. Still the range of concepts the Genevans have researched over the last fifty years has sampled the major curriculum areas well. Even though the Genevan intention was not to provide such a corpus, one by-product of their research of necessary knowledge is this corpus on the development over the school years of many important concepts in mathematics, logic, social studies, ethics, politics, physics, chemistry, biology, psychology, language and fine art.

In the main, the practical implications of Piaget's theory for education have already been made by others, and in fact what has really happened is that the theory has provided a theoretical justification for a number of long standing educational innovations.

Now, let us consider some commonly held Piagetian educational recommendations. A most ironic aspect of Piaget's acceptance by the educational reformers of the last twenty years was the vehicle by which he became widely known, namely Bruner's The Process of Education (1961). That book contained a famous hypothesis which while offered as compatible with Piaget in theory clearly could be seen as contradictory to it. "We begin," writes Bruner (1961, p. 32), "with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development" and with the corollary notion of a spiral curriculum. The issue is begged somewhat by the phrase "some intellectually honest form" but one clear feature of Piaget's account of the child's conceptual development is that the qualitative leaps in development make many later ideas inherently unavailable to the younger child. Bruner's hypothesis ignores the epigenic emergent assumption of Piagetian and other organismic developmental accounts. On the other hand there is a plausibility in Bruner's hypothesis which only points up again the difficulty in deriving educational practices from theory. Neither Bruner's hypothesis nor its opposite (viz., that by virtue of epigenesis some subjects cannot be taught with integrity) are proscribed by the theory.

Not to put a fine point on the matter, there are at least two other somewhat contradictory recommendations from the theory which are consistent with it. One recommendation is that instruction should "match" (Hunt, 1961) in some artful way the level of cognitive development the child has attained. In the early grades, for example, instruction and curriculum would recognize and push the limitations of preoperational and highly egocentric thought, and would not presuppose or demand, for example, hypothetical and inferential thought, or awareness of proportionality. The theory predicted that not until early adolescence would cognitive structure have developed to assimilate less concrete and more logically complex forms of information. Moreover, instruction in concepts before the prerequisite schemata have developed could result in serious "misacquisitions" (Flavell, 1963, p. 365) often indicated by a superficial verbal fluency such as "counting" without number conservation.

The second recommendation requires that instruction not match the level of the child's intellectual development at first, but rather that it begin at the most primitive and basic levels of cognitive development and move quickly through the stages of the pupil's intellectual history. This recommendation has been made by Piaget's colleague, Hans Aebli, and by Thomas Sticht. It is reminiscent of Werner's orthogenic and microgenic principles applied to the learning act in which the acquisition of a subject matter would recapitulate the stages in the development of the intellect. Since the principal concept in Piaget's theory is that mental operations are the result of the gradual transformation of overt actions, Aebli has suggested that instruction

> might begin by having the child operate directly on physical entities, then on pictorial representations of these entities, then have him proceed to cognitive anticipation and retrospections of operations not actually performed at the moment, and so on, until the originally external actions can take place internally and in complete autonomy from the environment (Flavell, 1963, pp. 368-369).

The difficulty, not only of deriving nonconflicting and specific educational practices from the theory, but of discovering specifically prohibited educational practices is also apparent.

Other than absurd practices that no theory recommends, specific proscriptions are more difficult to derive than might be imagined. Teaching by telling cannot be clearly proscribed, for example, due to the effectiveness of verbal rule instruction in the transition between preoperations and concrete operations. Ironically Brainerd (1973 and 1974) argued the Genevans violate their own theory by insisting, as they do, that the child support his conservation judgment with a reason, which appears to be the final testament to the difficulty in deriving straightforward practices from Piagetian theory as to be not recommended. Indeed Inhelder, Sinclair, Bovet (1974) have concluded that "programmed learning runs counter to the idea that for true learning to occur the child must be intellectually active" (p. 26). Let us consider this question of compatibility of programmed instruction and Piagetian theory.

The clearest educational recommendations from the operant theory for education are programmed instruction, computer assisted instruction, contingency managed classrooms, and token economies. Another commonly cited educational recommendation from Piagetian theory is discovery learning. However, when one teaches by the discovery method, one does very much the same kind of thing one could be doing when one teaches by the operant method.

In a very real sense the rat in the Skinner box 'discovers' the solution to its thirst as the laboratory scientist is 'programmed' by his laboratory, etc.

The procedural operations of discovery and programmed instruction can be identical as may be the theoretical operations Piaget hypothesizes to explain the child's responses to both situations.

While the differences between theories may not lead to different pedagogies they surely provide different explanations of teaching. Both Piaget and Skinner, for example, have different but adequate explanations for Montessori teaching. Neither explanation need influence Montessori practice, and Montessori practice is compatible with both theories. This should not be a particularly surprising state of affairs as there are many instances in science

and other disciplines where different theoretical positions yield the same practical recommendations. Both Ptolemeic and Copernican astronomies yield the same navigational practices, for example.

That various models result in different or identical educational practices is based partly on the fact that the connections between theory and practice are not deductions, but vague and imprecise analogies. However, it is possible that the teacher's belief in a model may influence the style of teaching and in this regard the different theories may lead to different pedagogical results (Stephens 1967). That there may be important differences in the behavior of operant and Piagetian teachers as their behavior is directed by their beliefs in the two theories may be as much a testimony of the restrictive interpretations each makes of the possibilities inherent in and compatible with the theories as it is of true differences in the models' consequences.

A major issue in curriculum design is the sequence of subject matters since, if for no other reason, everything cannot be learned at once. On this issue Piagetian theory would appear to be most useful containing, as it does, strong claims about the invariant sequence of intellectual development. While the dual recommendations of matching curricular demand and cognitive development or recapitulating that development in each learning episode have been mentioned, the long span of time the major stages cover can of necessity give little guidance to sequences within shorter time spans of the grade levels in any case. The well known horizontal decalage phenomena, on the other hand, do mark sequences within the stages and could be of some use, but they cannot be derived from the theory because the theory does not explain them. The horizontal decalage phenomena are theoretical anomalies and threats to the theory as it is presently formulated. The theory is by this fact of little use in the sequencing of the parts of new subject matters except to caution the educational planner to expect these structural anomalies.

While the sequencing of curricular content is an inescapable matter, the prior issue of curriculum development is, of course, the nature of the content itself. No psychological theory has statements in it that prescribes curricular content. To make the Piagetian tasks part of the curriculum is as misguided as teaching IQ items in an attempt to develop intelligence. To teach the properties of the logical models which describe intellectual operations as an attempt to foster intellectual development is equally wrong headed in that it confuses competence and performance models.

No doubt much of the attention Piaget has received by educators has been due to the surprising errors he discovered in children's conceptions. Presumably equally arresting errors remain to be discovered in children's understanding of other concepts in the traditional curriculum. However, the specific

character of the child's error in the operativity tasks is not treated in the theory. For example, of all the transformations that can be performed on an object, why are some taken by the child as actions that change weight and some taken as actions that do not change the weight of an object? We have found, for example (Nummedal and Murray, 1969; Haldas and Murray, 1974) that the source of these seductive transformations can be distinguished from non-seductive transformations through an analysis of the connotative meaning of the conservation concept in question. Changes in a clay ball's hardness, size, roughness, and strength, for example, were all thought by young children to affect the ball's weight and were all connotatively related to "heavy" and "light."

Piagetian psychology has been richest in its generation of instructional procedures. Between 1961 and 1978 over 150 research studies were published that were designed specifically to teach young children to conserve some attribute of an object. Quite apart from the theoretical reasons that motivated and legitimized the attention archival journals gave to the training of conservation, a number of precise teaching techniques were created and more importantly evaluated even if toward the end they added ever diminishing amounts of information of theoretical significance (e.g. Jeffrey, 1975).

A number of reviews of this training literature exist (viz. Beilin, 1971, 1977; Brainerd, 1973; Brainerd and Allen, 1971; Glaser and Resnick, 1972; Goldschmid, 1971; Peill, 1975; Strauss, 1972, 1974/75 and Murray, 1978) and indicate there is no longer doubt that nonconservers can be taught to conserve, although there is the somewhat pessimistic result that training, even highly individualized training, is either successful with about half the nonconservers in the sample or only half the gains in conservation that could be made are made by the nonconservers, although the gains fulfill the more demanding durability, extinction, and specific transfer criteria of the paradigm. This result seems quite independent of teaching time, although it is often, but not always, constrained by the child's substage of development (see Murray 1978).

By and large these procedures divide into procedures which assume nonconservation is due to a competence deficiency and those which assume it is due to a performance limitation.

All of the procedures can be shown sufficient within the limits cited for cognitive growth while none seem necessary for it. The success of any one relative to another, however, provides no guarantee that it more closely models the "natural" acquisition of a conservation than its inferior.

It should be noted that many of these training strategies are applicable to <u>all</u> concepts and have face validity as classroom techniques and in many instances would seem to be a teacher's

first response to a child who thought, for example, that the number of objects in a patterned array changed when the pattern changed.

The chief legacy of Piagetian theory for instruction will continue to be the development and evaluation of specific training techniques for various school concepts even if the success of the technique may be more parsimoniously explained by another theory. The value of a theory, and ultimately its truth, is in the uses to which it is put. Piagetian theory's value to education is by this criterion not in dispute if even specific educational practices are not deducible from it. Such logical entailment is rare in science, and virtually absent in the behavioral sciences, which leaves the discipline of education with a number of practices which are, while not derivable, at least consistent with the theory insofar as their not being specifically proscribed by it.

In summary, perhaps the only certain educational recommendation from a theory such as Piaget's is that schools should simulate "natural" human development; not that schooling is unnatural but rather it promotes intellectual growth best when it is based upon natural mechanisms of intellectual development.

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